49 Blue Kids

WORDS BY MARYANN BRINLEY // PHOTOGRAPH BY ANDREW HANENBERG

ON THIS FIRST COLD DAY OF FALL, the air was crisp and clear. Poison Information Specialist Wilma Pomerantz, RN, answered her phone at NJPIES mid-day. It was one of those calls that challenge, tax and require every ounce of mental acuity. On the telephone was a nurse at St. Mary's, an elementary school in Passaic. After being outside for recess, several children were there in her office complaining of nausea and headache. Their lips were blue.

"Blue?"

"Yes, blue."

Pomerantz's mind raced. Was it cold enough to turn lips blue? Had the kids been properly dressed outside? Could the blue be caused by a decrease in blood circulation? Were they eating berries around the playground?

"No. No. No." In fact, their hands and fingers were blue too. And it wasn't a color that could be wiped or washed off. As the two spoke, the number of children grew to five, six, then nine and ten. Several started to vomit and Pomerantz could now hear the chaos of crying, sick kids as the seconds ticked by.

"Contact parents and get emergency medical care," Pomerantz directed the nurse, as more sick students showed up. Emergency calls were made and the kids were soon being transported to different nearby hospitals.

Julia LaJoie, MD, in the pediatric emergency department at St. Joseph's Hospital in Paterson, was the first physician to examine several of the children. She suspected low oxygen levels which would explain the blue skin tinge. To check, she used a pulse oximeter probe, a device that indirectly measures the

This regular feature is designed to highlight cases from the files of UMDNJ physicians like Steven Marcus, MD, director of the New Jersey Poison Information and Education System (NJPIES) at UMDNJ-New Jersey Medical School (NJMS). Staffed by nurses, pharmacists and physicians, this phone bank of experts with its extensive computer database handles 100,000 calls annually about possible poison exposures. Puffer fish…near-deadly gulps of Snapple…teenagers smoking the fluorescent stuff in highway exit signs…a murderous angel of mercy … Over the past 40 years, Marcus, a veteran medical detective, has found himself immersed in so many intriguing medical dramas. This is definitely among his most colorful.

oxygen in blood based on an analysis of the blood's color beneath the skin in an earlobe or fingertip. Her suspicions were wrong. Although these children appeared blue, the pulse oximeter showed 88 percent, a level at which cyanosis, the blue color, is not expected. For these kids' degree of blueness, that oximeter should have read below 60 percent.

Luckily, LaJoie, a graduate of the pediatric residency program at the UMDNJ affiliate Morristown Memorial Hospital, had done a medical toxicology rotation at NJPIES and studied methemoglobinemia, a condition in which blood looks blue in spite of normal oxygen content. So, she drew enough blood for more testing and quickly sent it to her hospital's laboratory. She waited. And waited. Time was important and the lab knew this. "These kids were very sick," Marcus recalls.

What was wrong? Fifteen minutes passed before LaJoie called down for answers. Lab personnel had none. Or, they wouldn't provide them, explaining that their equipment had recently been adjusted. The technologist felt uncomfortable releasing results. In fact, the lab refused to share data until it was corroborated by another hospital's lab. This response was so strange and frustrating that LaJoie immediately picked up the phone to call Marcus at NJPIES.

"Steve, didn't you teach me that a cyanotic individual whose O2 saturation is normal is suffering from methemoglobinemia until proven otherwise?"

"Yes."

"Then why won't the lab give me the results?"

Marcus had no answer, just a hunch. Could the test results be so high that the lab couldn't believe their own numbers?

By now, blue children had been admitted to five area hospitals. LaJoie, Marcus and NJPIES experts suspected an environmental contaminant. With the exception of LaJoie, however, each hospital started treating for carbon monoxide poisoning, the wrong course of action. Marcus was concerned enough about the misdirected medicine that he dropped what he was doing and hopped in his "blue bomber," to drive to each hospital. Carbon monoxide had been presumed to be a probable cause because the school's heater had been turned on for the first time that October day. Though symptoms and signs were being attributed to the inhalation of this gas, Marcus knew that patients with carbon monoxide poisoning don't turn blue. He just couldn't explain how children playing outside after lunch would suddenly develop methemoglobinemia (MetHb). Yet, that had to be the working conclusion.

Methemoglobin is an aberration of the molecule hemoglobin, the oxygen-carrying component of blood. Hemoglobin can lose one of its electrons when exposed to the stress of various chemicals, drugs, or environmental contaminants, causing MetHb. The iron in hemoglobin becomes oxidized and as a result, a paradox occurs in which blood can neither carry nor release oxygen as it normally should.

When Marcus walked into the first examining room, he was struck by all the blue. Blue walls. Healthcare personnel in blue scrubs. Blue, sick students in blue hospital gowns, suffering from nausea, abdominal pain, vomiting, dizziness and headaches. "All the blue suddenly reminded me of the Smurfs" — that once-popular cartoon show, he recalls. But there was nothing funny about this scene.

Not until 5:00 p.m. would a lab confirm the MetHb diagnoses, and the children's levels ranged from 15 percent to 40 percent. Normal is less than 3 percent and more than 25 percent is dangerous. Fatigue, confusion, dizziness and palpitations are possible with MetHb concentrations of 30 to 50 percent. Above that, coma, seizures, arrhythmias and acidosis can occur. MetHb would eventually be diagnosed in 29 of the children and in others, levels were present but under 20 percent. In spite of confirmed diagnoses, for awhile doctors in two hospitals continued to believe that it was carbon monoxide poisoning, rejecting the appropriate management for MetHb.

Meanwhile, Marcus learned that school staffers were with 10 children at another hospital so he raced there to ask questions and discover clues. Lunchroom employees told him that the playground was not downwind from any commercial facility. Nor were there any potentially dangerous plants or bushes growing nearby. So he turned his attention to what happened right before recess. All the sick children had eaten soup during the second lunch period. Kids who skipped soup were fine. No other food consistently showed up in the diets of the sick students. Surprisingly, some children eating the soup remained well. Primarily, the students who had "second helpings" of soup were the sickest.

"Pretty quickly, I was able to narrow it down to this chicken noodle soup that had been commercially produced by a well-known manufacturer. But at first, we couldn't figure out how the contamination occurred. And the cook refused to provide information. I

needed to make the diagnosis," Marcus recalls. "She was a nun. Who was I to doubt her truthfulness?"

Was there any soup left over after lunch?

Yes.

Bottle and save it for testing, staff were told. Do it quickly.

Back at the school, lot numbers on unopened soup containers were checked for comparison to the soup served that day. When the numbers matched, the race was on to find all other cans out there on shelves, sold or unsold. Contaminated soup could have traveled all the way across the country with many potential victims. Calls went out while interviews continued. Left-over soup was also sent for testing. The fear was that the soup contained salt petre or sodium nitrite. This substance, used to cure beef, can be confused with salt and has produced outbreaks of MetHb in the past. Exposure to excessive levels of nitrite or nitrate will cause acute MetHb, when the nitrite binds to hemoglobin.

The cook insisted that the soup had been heated and served directly from the can. Nothing added.

Not even salt?

No. The lunchroom had no salt shakers.

Meanwhile back at the hospital, to treat MetHb, along with supplemental oxygen, the dye methylene blue was being administered to kids. This substance in conjunction with a kind of "electron donor" produced by normal body metabolism will reduce the methemoglobin, producing an oxidized methylene blue and changing the methemoglobin back to regular hemoglobin. While it may be unnerving to administer a blue dye to a blue patient, the patient soon turns healthy. So, in this situation, 49 blue children soon turned pink. "And as the methylene blue dye cleared from their bodies, the blue kids' urine also turned blue/green, to the amazement of everyone involved," Marcus recalls.

But the search was still on. What caused the MetHb if not the soup? Marcus turned back to the cook, who under more questioning, finally admitted that she had been afraid of running out of soup during that second lunch period, so she started "stretching it" with tap water from the kitchen sink.

By this time, the State Department of Health and the Division of Consumer Product Safety were also involved.

Once it had become near epidemiologically certain that the soup was the source, the Department of Health embargoed all the school's chicken noodle soup cans. The state's lab analyses soon found the nitrite concentration of the soup mixed with the cook's tap water to be extremely high while the nitrite in unopened cans was negligible. The culprit wasn't in the can. This news sent the local health department team back into the school building to examine the plumbing system since their water supply came from the municipal system. Tap water throughout the school showed no significant nitrite concentration. Then, records of school repairs were reviewed.

The answer.

Just one week before, the heating system had undergone its annual repair and safety check. An anti-corrosive agent, a combination of sodium borate and sodium nitrite, had been added to the boiler. Rather than emptying the boiler completely, the repair service added this agent to the water already there. So back in the state lab, the diluted soup was checked further for borate. This test was positive and a link between the boiler water and the soup was established. But how could this chemical additive in the boiler start flowing directly from the kitchen tap?

Normal engineering controls include a check valve between a boiler system and the potable water in a building. When inspected, the check valve at the school was old, in need of replacement, but it appeared functional. Thus, the most likely explanation is that this valve got stuck open when the boiler started firing that day, creating a pressure differential between the boiler and the kitchen sink. This must have led to movement of water straight from the boiler, right into the kitchen tap, and on into the watered-down soup.

Though this case occurred in the 1990s, these check valves are still commonly found in private homes and institutional buildings because they allow easy refilling of boiler water and maintain a proper level of water for heating. Marcus has seen other instances of check valve failure causing contamination of the water supply. It can happen in heating or cooling systems because both rely on re-circulated water and are connected to potable water sources. The school's water system was flushed, water from all taps was retested and found to be fine. As a result of this nightmare, St. Mary's stopped heating water through its boiler coils. "It is imperative that proper maintenance be carried out on all these systems to ensure everything is functioning correctly," Marcus advises.

Needless to say, a new check valve was also installed at St. Mary's immediately, putting an end to the school's blue period. Even more gratifying: all the children fully recovered within 24 hours with no complications. ■

"PRETTY QUICKLY, I WAS ABLE to narrow it down to this chicken noodle soup that had been commercially produced by a well-known manufacturer. But at first, we couldn't figure out how the contamination occurred. And the cook refused to provide information ..."